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High-k dielectrics on n-$Al_{0.25}Ga_{0.75}N$ via atomic layer deposition N. NEPAL, N.Y. GARCES, D. MEYER, T.J. ANDERSON, J.K. HITE, M.A. MASTRO, C.R. EDDY, JR., U.S. Naval Research Laboratory, Washington, DC 20375, USA — AlGaN/GaN and AlInN/GaN high-electron-mobility transistors (HEMTs) are promising devices for high-temperature and high-power electronics applications. A key issue with these devices is the high gate leakage current, particularly for enhancement-mode HEMTs. There has been an increased interest in developing high quality gate insulators to reduce gate leakage current. $Al_2O_3$and HfO_2 layers (21nm thick)were deposited via atomic layer deposition on n-$Al_{0.25}Ga_{0.75}N$ pretreated with one of two different surface preparations, H_2O_2:H_2SO_4 (1:5) (piranha) or HF:H_2O (1:3). Dielectrics were characterized using spectroscopic ellipsometry, X-ray photoelectron spectroscopy, atomic force microscopy (AFM), and capacitance-voltage (C-V) measurements. AFM shows that $Al_2O_3$and HfO_2 layers are continuous and uniform in thickness on both HF and piranha pretreated surfaces. However, C-V measurement shows smaller (15%) hysteresis for HF pretreated samples. The estimated dielectric constants (ε) are 9 and 18 for Al_2O_3 and HfO_2 on HF pretreated surfaces, respectively, in general agreement with theoretical values of 9 and 25. Al_2O_3 layers on $Al_{0.25}Ga_{0.75}N$ exhibited a lower leakage (7x10^{-8} A/cm^2 at 5 V) current and higher forward breakdown voltage of 7.5 MV/cm compared to that of HfO_2 layer. The higher breakdown voltage and lower leakage current for Al_2O_3 is due to larger conduction band offset with $Al_{0.25}Ga_{0.75}N$.

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